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Program to Determine Radiating, Nonadiabatic, Inviscid Flow Over a Blunt Body by the Method of Integral Relations

The problem:

To perform the many calculations necessary for solving the radiating nonadiabatic flow of air in chemical equilibrium. The results would describe a blunt-body flow field in the subsonic region.

The solution:

A computer program was developed in support of the study of the radiating, nonadiabatic, inviscid flow properties (pressure, temperature, density, velocity, and enthalpy) around a blunt body in equilibrium air by use of a modified method of integral relations.

How it's done:

The program calculates the radiating nonadiabatic flow of air in chemical equilibrium. Results obtained agree with results from inverse and time-dependent techniques. The agreement indicates that this method of solution provides an accurate description of the blunt-body flow field in the subsonic region.

The equations which govern inviscid, radiating, nonadiabatic steady flow of equilibrium air over a blunt body travelling at hypersonic speeds are a system of non-linear partial differential equations derived from the laws of conservation of mass, momentum, and energy. The modified method of integral relations is used to transform the governing equations into a set of ordinary differential equations that are numerically integrated to yield the details of the thermodynamic and flow prop-

erties within the shock layer. Provisions have been made in the governing equations for coupled radiating flow-field analysis.

The governing differential equations are solved by a fourth-order Runge-Kutta integration technique to give shock-layer thickness, shock angle, and the fluxes of mass, momentum, and energy at the body surface.

The documentation contains a description of the computer program along with the methods used in the digital approximations, flow charts, instructions for the user, and a test case with input and output listings.

Notes:

1. This program is written in FORTRAN IV to be utilized by the CDC-6600 computer.
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